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AUTHOR Grubb, Henry Jefferson
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ABSTRACT

One important source of biological determinants to intellectual behavior is the immediate family of origin. When family history is taken into consideration, it is necessary to examine the environmental aspects of intellectual development in conjunction with the biological. Herein lies the usefulness of a transactional model of development over main-effect and interactional models. A transactional view sees the two processes as a compound -- each substance entering a relationship with the other such that both are transformed into a new entity. In the family, transactions arise that are centered around the interface of the biological and environmental spheres and give rise to a dynamic interplay of interpersonal relationships which foster the propagation of a vicious cycle, maintaining the original biological and environmental variables intergenerationally. Some factors that affect human intelligence can presently be listed: sex, socioeconomic status, region of residence, the urban-rural dichotomy, malnourishment, infection, disease, and certain handicaps; it is held that all such variables ultimately will be determined to be environmental. Listing environmental influences does not, however, lead to an understanding of how intelligence develops. A transactional model of intellectual development can be formed by combining Piagetian, learning, and information-processing theories. The transactional model would include developmental stage concepts, mechanisms of information acquisition, processes by which stages are accomplished, and meta-learning processes, the last of these being particularly important for understanding intelligence. (RH)

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A Developmental Perspective on Intelligence

Henry Jefferson Grubb

Virginia Polytechnic Institute & State University

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Abstract

"How does intelligence develop?" The development of intelligence is seen from a developmental perspective, and this is contrasted with non-developmental models of intelligence.

A Developmental Perspective on Intelligence

A developmental model of intelligence would be a transactional model. It would include biological and environmental factors in a synergistic approach to the question. The combination of biological, environmental, nutritional, cultural, and social factors would be interactive, one upon all others, and the effect of all on intelligence would be more than the sum of effects of the individual determinants. Teasing out which variables influencing intelligence predate other factors would be a very difficult operation because all the important variables are active (or possess the potential to be active) at all stages of an organism's life, as will become evident from the text that follows. Even before the neonatal period (and even prior to conception) the entire range of controlling variables are already operative in mutual multi-dimensional dialectics, constantly being transformed and constantly transforming.

To begin understanding intelligence in the individual human, one must first understand intelligence in the human species. Hall et al. (1982) identify species intelligence as "the disposition to behave adaptively when faced with the demands of the environment." They further state that as a species moves up the phylogenic ladder, becoming more intelligent, the amount of learned behavior increases while the percentage of instinctual behavior declines. Mankind can be therefore viewed as an animal slighted by nature in the fixed knowledge area, those few traits considered instinctual to the species being quite evenly distributed throughout the population by the process of natural selection (Hall, Lamb, and Perlmutter, 1982; Hamilton, 1964).

Watson goes as far as to state that "there are no instincts or inherited capacities or talents of any kind (endowed by evoluation on humankind)" (Schultz, 1975). Because of the peculiar evolutionary niche in which mankind has been driven, the species lives in a symbollically created universe which each member organism

must "learn" as it develops. This is not to say that there are no biological factors still at work in the formation of adult intelligence but that human intelligence is radically different from that under which the vast majority of earthly species operate.

One important source of biological determinants to intellectual behavior is the immediate family of origin. Humans selectively mate. Lower socio-economic (SES) persons usually mate with members of their own class, Blacks usually mate with other Blacks, tall females usually mate with tall men. Even though all this selective mating is intertwined with social and cultural mores, traditions, and even legal statutes, the effect of one function upon the other, and specifically the biological cause and consequence is undeniable. Zeskind and Ramey (1981) investigated the maternal history of infants with low Rohrer's ponderal indexes (PI) and found that, compared to matched controls, these mothers had significantly lower IQs (as measured on the WAIS), more obstetric problems (miscarriages and premature births), and more health related problems. The evidence would seem to suggest that those mothers with lower adult intellectual functioning tend to rear more children on the same order, if no outside intervention is provided.

When considering family history it is of course necessary to examine the environmental aspects of intellectual development in conjunction with the biological. Herein lies the usefulness of a transactional model of development over main-effect and interactional models. A transactional view sees the two processes, to use a chemical analogy, not as a mixture with each substance retaining its original significance and quantifiable in percentage contribuiton, but as a compound - each substance entering a relationship with the other in which both are transformed to form a new entity. Transactions arise centered around the interface of the biological and environmental spheres that give rise to a dynamic

interplay of interpersonal relationships which foster the propagation of a vicious cycle, maintaining the original biological and environmental variables intergenerationally.

By manipulating only certain environmental aspects which correlate with depressed infant intellectual behavior, Zeskind and Ramey (1978, 1981) were able to demonstrate that the control of one part of a dynamic assemblage produced a synergistic change in the desired direction on performance measures. Simple addition of outside (non-maternal) positive interpersonal interaction with very young infants ameliorated the devastating effects of poverty, poor parenting skills, and intergenerational influences. This result was possible, to rarefy the parlance of transactionalism, because the whole is more than the sum of the parts and therefore the removal of any part radically changes the quality of the whole. Only a transactional model would predict such an outcome.

Keeping in mind that all variables impacting on the development of intelligence are transformed continually by the transactions taking place between them and other variables at work, we can now list osme of the various known determinants and their "singular" effects on IQ. Factors such as sex, SES, region of residence, and the urban-rural dicotomy have been shown to affect what an individual knows as measured on standardized tests of intellectual ability (Reynolds and Nigl, 1981; Kaufman and Kaufman, 1973). Males and females learn different behavior in our society but the material on IQ tests are so constructed that no difference between the sexes is apparent on the most widely used assessment instruments (Hall, Lamb, and Perlmutter, 1982; Taylor, 1976). The SES of a child's family of origin is directly correlated with IQ scoring, whereas city dwellers outscore cohorts living in rural areas and those children living in the North and East outperform those being raised in the South and West. The absence of a father has been found to correlate directly with lower IQ in most studies (Greenberg and Davidson, 1972;

Carter and Walsh, 1980; Deutsch, 1960). The educational level of a child's parents (especially that of a present father on his son (Hall, Lamb, and Perlmutter, 1982)) also has a direct correlation with the childs' measured IQ (Greenberg and Davidson, 1972). The number of children in the family is inversely correlated with performance on tests of intellect (Olneck and Bills, 1979) as is the person/room ratio in the home (Greenberg and Davidson, 1972). Educational levle of the teachers in the school where a child attends is also correlated with the IQ of the child - directly (Lindsay, 1980); an obvious but often overlooked fact.

Malnurishment either pre -or post-natally has been shown to have a detrimental effect on IQ (Birch, 1972) as has many forms of infection, disease, and certain handicaps (Hall, Lamb, and Perlmutter, 1982). Blind and deaf children learn at different rates and have knowledge of their environment that is not the same as that of non-handicapped siblings.

Many investigators are currently cataloguing the environmental (and biological) agents that affect intellectual growth. The listing given above is by necessity incomplete and only set down in order to give the reader an idea of the diversity of the influences affecting the topic behavior. The author is particularly interested in the compilation of the environmental variables, even going so far as to believe that all the variables will ultimately be determined to be environmental based on the current thinking in social biology (Hamilton, 1964).

Knowledge and listing of those environmental influences does not lead one to and understanding of how intelligence develops however. This point is another deficit in main effect and interactional models of development - they only catalogue those variables correlated with intelligence. Jensen (1969), a leading proponent of the hereditary main effect model, can even feel free to claim that 80 percent of the difference between individuals is the results of genetics. A close inspection of his theoretical formulation will clearly prove the fallacy of his assumptions

(Conwill, 1980; Taylor, 1979), however he shares one problem common to all non-transactional developmental psychologist: the mere knowledge of what factors correlate with intellectual development does not explain how those same factors influence the development of intelligence. A transactional model does.

Based on an amalgamation of Piagetian, learning, and information processing theories we can formulate a transactional model of intellectual development. Piaget gives us a rather complete listing of the different stages infants and children traverse in order to develop adult intellectual behavior. Piaget begins this developmental journey at birth, and although it can effectively be argued that the development of intelligence has already been in progress for some nine months, little experimental data has been accumulated concerning the interuterine human.

Learning-based theory allows us to understand the mechanisms involved in the acquistion of discrete bits of information by the individual. Within the cognitive framework of a sub-stage's schema, learning theory is quite effective in detailing how new behaviors are added to ones repetoir or how old behaviors are modified or lost. Concepts such as operant and classical conditioning, reinforcement schedules, and extinction go far to explain intellectual change and development. Broadening learning theory to include social learning concepts such as modeling and attribution helps us more clearly see the process of development at work.

When the information-processing approach is also added to the equation greater understanding of the acquistion of intelligence is gained but more importantly, some insight into the transmutation of the piagetian stages is revealed. Gagne (1968), a learning theorist, believes that children do not shift magically from one stage to the next but that slow cumulative learning explains the switch from pre-operational to concrete operational stages, for instance.

Sternberg (1977) makes a more subtle and more convincing argument when he tackles the distinction between learning (intra stage acquision of knowledge) and development (the reorganization of one's chemas). Sternberg believes learning principles can explain the former while meta-learning is required to explain the later.

A child learns how to push a ball off a table by trial-and-error, reinforcement, and driven by curiosity (learning) but a child moves from the sensorimotor stage to the preoperational stage by constant repitition of the learning paradigms until an understanding of what is learned - is learned. Meta-learning is therefore knowledge of knowledge. Sternberg (1979) believes that once we begin to analyse intelligence at the meta-learning or meta-knowledge level (his term: metacomponents), we will be able to more fully grasp the concept of intelligence, its hows and whys, and lay down principles as firm as those already laid down at the learning level.

It is suggested that experimentation now be conducted to determine how one correlate relates to (is changed by, changes) other correlates of intelligence. Now that we possess a good amount of knowledge on simple effects of various environments of the development of intelligence, it is time to manipulate the interaction of these settings in order to determine their transactional effect on intelligence. Only then will we be able to say more than what is intelligence (ability to learn). Then we will move toward defining the process of intelligence (the ability to know the ability to learn) and the process of the development of intelligence (the ability to understand the formation of the ability know the ability to learn and the ability to learn).

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